

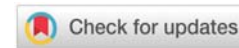


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Research Article

Do dental screening and treatments prior to heart valve interventions help prevent prosthetic valve endocarditis? A systematic review

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Abstract

Routine screening for infectious dental foci prior to elective heart valve replacement may help prevent postoperative Prosthetic Valve Endocarditis (PVE), a potentially fatal complication. This systematic review assesses the effect of routine screening for infectious dental foci on the incidence of postoperative PVE. The Cochrane Library, PubMed and EMBASE databases were all searched for relevant primary studies. The GRADE system was used to rate the studies. Three primary studies with a very low level of evidence were included in the review. No significant difference was found between the incidence of PVE in groups with or without routine screening for infectious dental foci prior to heart valve replacement. The results of this review do not support or disprove the need for preoperative screening for infectious dental foci to prevent PVE in patients undergoing heart valve replacement. Further research is necessary.

Introduction

In the Netherlands, most cardiothoracic surgery referral centers prefer screening for infectious dental foci before patients are approved for heart valve replacement. This screening includes a clinical and X-ray examination of dental pathology compliant with the national NVMKA guideline. The screening and subsequent treatments (when necessary) aim to prevent postoperative Prosthetic Valve Endocarditis (PVE) within one year of valve replacement. However, the relevance of such screening is unclear.

The incidence of PVE after heart valve replacement is low (1%–6%) [1,2], but it is a life-threatening complication with a mortality rate of 50%–60% [3]. Typical bacteria related to infective endocarditis include Viridans group streptococci, such as *S. bovis*, *Haemophilus* spp., *Aggregatibacter actinomycetemcomitans*, *Cardiobacterium hominis*, *Eikenella corodens*, *Kingella kingae*, *K. denitrificans*, *Staphylococcus aureus* and community-acquired enterococci in the absence of a primary focus [4–6]. The majority of these bacteria are commensal in the oral-pharyngeal region.



The mouth is well-known as a possible focus for infections occurring elsewhere in the body [7]. A focus is defined as a source of inflammation and the center of a disease process. Periodontitis and other dental diseases can serve as a primary focus for PVE [8-10]. Predisposing cardiac lesions, previous valve replacement, male sex and a stenotic valve are also associated with infective endocarditis [3-11]. In addition, the removal of dental foci prior to heart valve surgery may be mentally and physically stressful for some patients, and the effects of removing dental foci on the risk of PVE are unclear. Therefore, this review assesses the effects of dental screening and treatments on the incidence of postoperative PVE in patients undergoing heart valve replacement.

Materials and methods

Eligibility criteria

All studies, with the exception of guidelines, letters, position papers, consensus statements, and reviews available by the same author, published between 1980 and April 2022 were included in this review (Table 1). All included studies were in English, German, or Dutch and included adults (>18 years of age). The literature search was performed in May 2022 by an author and a library information specialist at Amphia Hospital and the Leiden University Medical Center. The Cochrane Library, PubMed, and EMBASE databases were searched using appropriate search terms (Figure 1, Table 2).

To provide a clear structure and ensure transparent reporting of the results, the PRISMA guidelines were used to conduct this systematic review [12].

Study selection

Two authors assessed the extracted studies by title and abstract. Then, the full texts of selected studies were assessed (Table 3). When the eligibility of a study was unclear, the study underwent a full-text assessment. There were no disagreements during the screening process.

Table 1: Parameters of interest and inclusion criteria for studies.

| Population | Intervention | Comparison | Outcome |
|--|---|------------------------------|--------------------------------------|
| Patients prior to heart valve intervention | Screening for dental foci | No screening for dental foci | Postoperative endocarditis (primary) |
| Inclusion criteria | Article in English, German, or Dutch Published between 1980 – April 2022 Randomized controlled trial Prospective studies Retrospective studies Case-control studies Case series (>10 patients) Adults (> 18 years old) | | |
| Exclusion criteria | Animal studies In vitro studies Lack of follow up Guidelines Letters Consensus statements Position papers Technical letters | | |

Cochrane:
Search terms: "dental", "dentistry," and "endocarditis"

PubMed:
("dental screening"[tiab] OR "dental foci"[tiab] OR "dental treatment"[tiab] OR "dental care"[tiab] OR "dental status"[tiab] OR "dental procedure"[tiab] OR "oral health"[Mesh] OR "oral care"[tiab])
AND
("valve replacement"[tiab] OR "valve intervention"[tiab] OR "valve surgery"[tiab] OR "heart valve"[tiab] OR "cardiac valve"[tiab] OR "cardiac surgical procedures"[Mesh] OR "heart surgery"[tiab] OR "TAVI"[tiab] OR "transcatheter aortic valve implantation"[tiab] OR "TAVR"[tiab] OR "transcatheter aortic valve replacement"[tiab])
AND
("endocarditis"[Mesh] OR "endocarditides"[tiab] OR "infective endocarditis"[tiab] OR "bacterial endocarditis"[tiab] OR "infection"[tiab] OR "bacteremia"[Mesh])

EMBASE:
Advanced search: ("dental screening".ti.ab. OR "dental foci".ti.ab. OR "dental treatment".ti.ab. OR "dental care".ti.ab. OR "dental status".ti.ab. OR "dental procedure".ti.ab. OR exp dental health/ OR "oral care".ti.ab.) AND ("valve replacement".ti.ab. OR "valve intervention".ti.ab. OR "valve surgery".ti.ab. OR "heart valve".ti.ab. OR "cardiac valve".ti.ab. OR "exp heart surgery".ti.ab. OR "heart surgery".ti.ab. OR "TAVI".ti.ab. OR "transcatheter aortic valve implantation".ti.ab. OR "TAVR".ti.ab. OR "transcatheter aortic valve replacement".ti.ab.) AND ("exp endocarditis".ti.ab. OR "endocarditides".ti.ab. OR "infective endocarditis".ti.ab. OR "bacterial endocarditis".ti.ab. OR "infection".ti.ab. OR "exp bacteremia".ti.ab.)

Figure 1: Search strategy.
Contains the search strategy in The Cochrane Library, PubMed, and EMBASE.

Table 2: PICO and search terms.

| Population | Intervention | Comparison | Outcome |
|---|--|------------------------------|--|
| Patients prior to heart valve intervention | Screening for dental foci | No screening for dental foci | Postoperative endocarditis (primary) |
| Valve replacement Valve intervention Valve surgery Heart valve Cardiac valve Cardiac surgical procedures [Mesh] Heart surgery/TAVI (transcatheter aortic valve implantation) TAVR (transcatheter aortic valve replacement) | Dental screening Dental foci Focal infection, dental [Mesh] Dental treatment Dental care Dental status Dental procedure Oral health [Mesh] Oral care | | Endocarditis [Mesh] Endocarditides Infective endocarditis Bacterial endocarditis Infection Bacteraemia [Mesh] |

Table 3: Articles excluded based on assessment of full text.

| First author | Study | Year | Reason of exclusion |
|---------------------|--|------|-----------------------------|
| Kolk | "The influence of surgical and restorative dental treatment prior to cardiac valve surgery on the long-term demand of dental treatment: a prospective clinical study." | 2009 | Intervention |
| Nakamura | "Prevalence of periodontitis and optimal timing of dental treatment in patients undergoing heart valve surgery." | 2011 | Intervention |
| Bratel | "Treatment of oral infections prior to heart valve surgery does not improve long-term survival." | 2011 | Outcome |
| Carasso | "Dental screening prior to valve interventions: should we prepare transcatheter aortic valve replacement candidates for "surgery"." | 2019 | Intervention and Population |
| Konstanty-Kalandyck | "Incomplete oral sanitation as a risk factor for elevated leucocytosis and postoperative infection." | 2016 | Outcome |
| Krennmair | "Odontogenic infection sources in patients scheduled for cardiac valve replacement." | 2007 | Outcome |
| Lassnig | "Infection sources in HNO- and jawbone regions in patients before valve replacement surgery." | 2004 | Intervention and Population |
| Yansy | "Dental considerations for cardiac surgery." | 2008 | Study type |

Quality of evidence

The GRADE method was used to rate the quality of the included primary studies, which were categorized as high, moderate, low, or very low [13,14].

Data parameters

The number of patients, patient age, patient sex, length of follow-up, type of intervention, control group, and relevant outcomes was extracted from the studies. The primary outcome measurement was PVE and the intended independent study variables were dental foci or dental screening. Descriptive statistics were used to summarize the data set.

Meta-analysis

The incidence of PVE was calculated in the intervention and control groups of the three studies included in this review. The data were analyzed using Review Manager Version 5.4.1 (Cochrane, London). An overall risk ratio and risk difference of PVE were calculated using a dichotomous setting with an inverse variance and, due to the expected heterogeneity, a random effect. The heterogeneity was calculated using the I^2 and Chi-square coefficients. The confidence intervals were set at 95%.

Results

Search results

Two articles were retrieved from the Cochrane library, 111 from PubMed, and 245 from Embase (Figure 2). After removing duplicates and assessing the titles and abstracts, ten studies underwent a full-text assessment. Two articles were found to be eligible for inclusion in this review. A search of the references

of the ten full-text articles resulted in an additional study that was included in this review (Table 4). The GRADE method was used to rate the quality of the included studies (Table 5). Extracted data from the included studies were bundled in Table 6.

A meta-analysis was conducted using data from the three included studies to determine the effects of dental screening on the risk of PVE. The incidence of PVE was not significantly different between patients who underwent preoperative dental screening and those who did not ($p = 0.74$). There was moderate heterogeneity between the studies ($p = 0.16$, $I^2 = 46\%$) (Figure 3). The risk difference for developing PVE was 0%, indicating no overall effect between the screening and no screening groups (Figure 4).

Discussion

This systematic review assesses the effect of preoperative dental screening on the risk of PVE in patients who underwent a heart valve replacement. However, this review only includes three studies with low-GRADE ratings. No significant differences in the risk of PVE between patients who underwent preoperative dental screening and those who did not were identified. Furthermore, a meta-analysis of these studies was less reliable due to the heterogeneity of the study populations, control groups, and follow-up periods. The results of the dental screenings and subsequent treatments are unclear in the included studies. Therefore, the benefits of preoperative dental screening on PVE risk remain unclear [15,16].

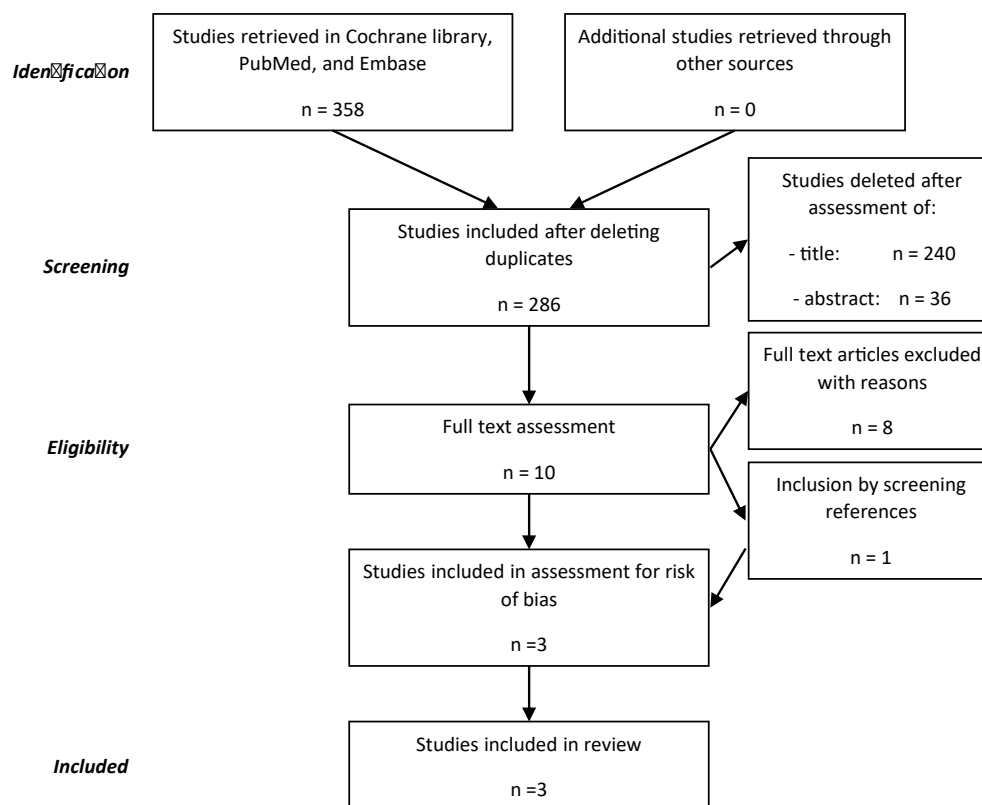


Figure 2: PRISMA flow chart.

Contains the flow chart, following the PRISMA statement for reporting systematic reviews and meta-analyses [15], used for in- or excluding the studies.



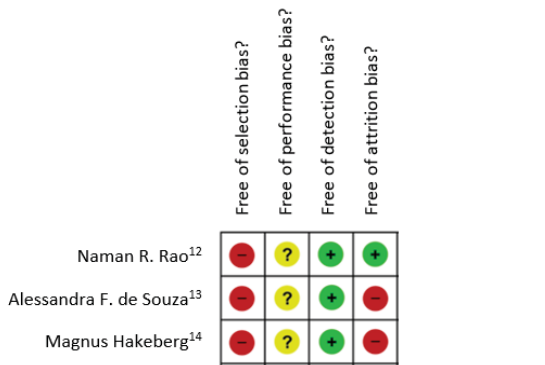
The incidence of PVE in the studies included in this review ranges from 0.3%–8.4%. This wide range may be due to differences in the onset of PVE and the limited follow-up period in two of the included studies. Early PVE is defined as a disease within one year of surgery, and late PVE occurs more than

Table 4: Included articles.

| Title | First author | Year of publication |
|---|------------------------|---------------------|
| Preoperative dental screening prior to cardiac valve surgery and 90-day postoperatively mortality [17]. | Naman R. Rao | 2020 |
| Dental care before cardiac valve surgery: Is it important to prevent infective endocarditis? [19] | Alessandra F. de Souza | 2016 |
| The significance of oral health and dental treatment for the postoperative outcome of heart valve surgery [18]. | Magnus Hakeberg | 1999 |

Table 5: Level of evidence, risk of bias, and GRADE ratings of included studies.

| First author | Level of evidence study type | cBias | GRADE |
|-----------------------------|------------------------------|---|----------|
| Naman R Rao [17] | Low (retrospective) | Inconsistency of heterogeneity of patient group (subgroup analysis is included) | Low |
| Alessandra F. de Souza [19] | Low (retrospective) | Imprecision in sufficient patients Inconsistency of heterogeneity of patient group (subgroup analysis is included) | Very low |
| Magnus Hakeberg [18] | Moderate (prospective) | Imprecision in sufficient patients Inconsistency of heterogeneity of patient group (no randomization in selected groups) | Very low |



one year after surgery. The differences in early and late PVE may be important, as the valve implant may be contaminated during or directly after the valve surgery or may replicate valve endocarditis in a non-implant natural valve. The types of PVE have different origins (including focal entrance and type of bacteria) and prevention methods [1,5,6]. And are most likely not only caused by dental foci.

Two studies included in this review [17,18] have a short follow-up period (3–6 months), which may account for the lower incidence of PVE, as late PVE is not included or partially included. The incidence of PVE in the remaining study [13] included in this review is high compared to other previous studies [20–22]. This high incidence of PVE should be interpreted with caution as it is not explained in the previous study [19].

One study in this review included a higher rate of PVE in men (11%) than in women (6%) and found that PVE tended to occur in younger patients, though no possible reasons for these results were provided [19]. A higher incidence of PVE in men (4.6% vs. 2.6% in women) was also reported by Myllykangas, et al. [23]. As previously reported, the mortality rate of coronary heart disease is higher in men than in women [24]. It has also been reported that men have a higher incidence of periodontitis and oral cancer and worse oral hygiene than women [25]. These risk factors may contribute to the higher incidence of PVE in men.

To understand the association between dental foci and PVE, the relationship between oral and systemic health must be studied. While several studies have reported associations between dental infections and coronary heart disease diabetes, osteoporosis, respiratory diseases, and poor pregnancy outcomes, the relationship between oral and systemic health remains unclear. Odontogenic bacteremia may lead to systemic infections, though these infections are often mild in healthy patients. However, odontogenic bacteremia may lead to severe infection if not sufficiently treated. Therefore, an understanding of the role of oral health and the risks related to poor oral health is important.

The effects of dental screening on the incidence of early

Table 6: Extracted data.

| First Author | Population | Follow up | Intervention | Control | Outcome |
|-----------------------------|---|---|---|---|--|
| Naman R. Rao [17] | 1,835 patients (1081 men and 753 women) 54-83 years old | 3 months | 1,143 patients underwent a focused dental approach (based on clinical examination and limited radiographic screening) | 692 patients underwent a comprehensive approach (full radiographic screening) | PVE: 0.3% of patients in intervention group PVE: 0.9% of patients in control group (p = 0.159) |
| Alessandra F. de Souza [19] | 481 patients (210 men and 261 women) 31-67 years old | 12 months | 110 patients underwent dental treatment prior to cardiac valve surgery | 371 patients did not undergo dental treatment | PVE: 6.4% of patients in intervention group PVE: 8.4% of patients in control group (p = 0.496) |
| Magnus Hakeberg [18] | 253 patients (145 men and 108 women) 47-75 years old | 6 months (PVE evaluation after two weeks) | 149 patients underwent dental treatment prior to cardiac valve surgery | 104 patients did not undergo dental treatment | PVE or sepsis: 5.4% of patients in intervention group PVE or sepsis: 1.9% of patients in control group (p > 0.05) |

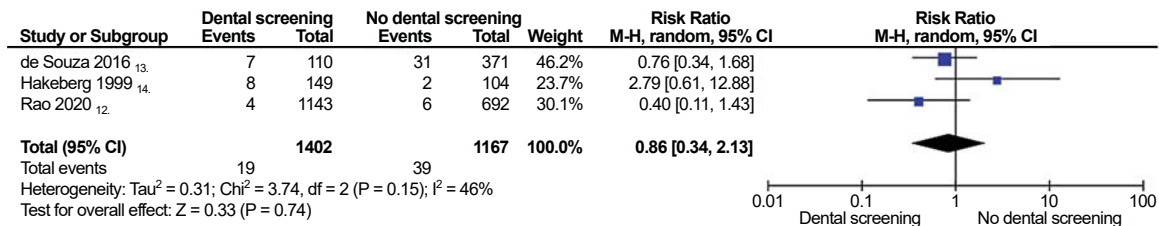


Figure 3: Risk ratio table.
 Tabulates the risk ratio for the heterogeneity between the studies. There is moderate heterogeneity between the studies.

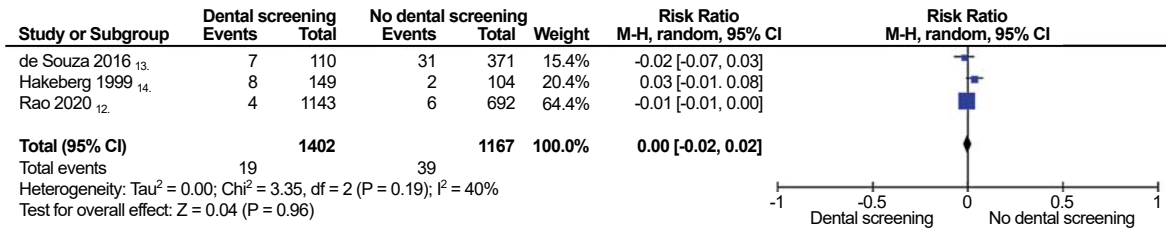


Figure 4: Risk difference table
 Tabulates the risk difference for developing PVE. There is no overall effect between the screening and no screening groups.

PVE remain unclear [26]. The three studies included in this review concluded that there is a relationship between dental screening and treatment that cannot be supported by the current evidence. The necessity of preoperative dental screening to prevent PVE is unclear. More research is required to understand this relationship.

Patients requiring valve surgery typically have physical and psychological comorbidities. Dental treatments may result in burdens to an already-stressed patient, resulting in worsened conditions, including malnutrition [27-29]. Dental screening prior to heart valve surgery often leads to tooth extractions and 44% of patients are stressed when faced with tooth extractions [30]. The surgical treatment of dental foci may require medication changes or prophylactic antibiotics, which are inconvenient for patients, though not life-threatening [31].

When no dental screening or treatment is conducted prior to heart valve replacement, the overall cost of care is reduced. Furthermore, cardiac surgery will not be delayed by dental treatments. Some dental findings do not require treatment. However, obvious dental pathology must be treated. The European Society of Cardiology (ESC) guidelines strongly recommend strict oral hygiene and follow-up to prevent infectious endocarditis in patients at high risk of PVE, especially after cardiovascular interventions. Furthermore, despite previous research showing that minor oral surgeries can be performed safely in patients receiving antiplatelets or anticoagulants, patients who did not discontinue anticoagulant therapy had significantly increased intraoperative bleeding and a higher incidence of complications after dental treatment [32,33]. Therefore, changes to the patient's anticoagulant regimen should include drugs with fewer risks prior to dental treatment. The resolution of dental problems prior to valve replacement should be considered to avoid changes to the postoperative anticoagulation regimen [34,35].

Therefore, the necessity and efficacy of dental screening and treatments prior to heart valve replacement remain unclear. However, as only three studies with a low level of evidence were included in this review, more research with a higher level of evidence is needed. A prospective, randomized study with a longer follow-up period (≥ 12 months) or a multicenter cohort study is recommended.

In conclusion, the results of this review do not support or disprove the need for preoperative dental screening for the prevention of PVE after heart valve replacement. More research is necessary to investigate the effects of dental screening on the risk of PVE due to the lack of evidence found in the current literature.

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